

**APPENDIX A**

**CALCULATING EMISSIONS FROM ROADSIDE TEST RESULTS**

Although the results cannot be compared to the 1994 State Implementation Plan (SIP) targets, we also estimated the emission reductions achieved by Enhanced I/M using our latest emission inventory data, based on the results of roadside testing (as described in Chapter III) and the draft EMFAC2000 model. With this approach, we estimate that the Enhanced I/M program actually achieved emission reductions of 123 tons per day of hydrocarbons (HC) plus nitrogen oxides (NOx) in 1999, as shown in Table A-1. These are the appropriate reduction estimates to use in calculating the cost-effectiveness of the program for Summer 1999.

**Table A-1**  
**Emission Reductions from Enhanced I/M in 1999<sup>1,2</sup>**  
(tons per day)

HC (exhaust + evaporative)	NOx	Carbon monoxide
99	24	776

<sup>1</sup> Cannot be compared to 1994 SIP commitment for attainment and conformity purposes. (See Chapter V for further discussion)

<sup>2</sup> Does not reflect tighter NOx cut points implemented in October 1999.

The emission reductions shown in Table A-1 cannot be used to compare against the legal targets established by California's 1994 SIP for ozone. The 1994 SIP uses older emission models and assumptions that were frozen in time by federal approval of the plan. The emission reductions shown in Table A-1 are higher than the SIP estimates because we now believe overall emissions from vehicles are greater than previously estimated – resulting in more emissions to be reduced by programs like Enhanced I/M.

We calculated the tons of exhaust emissions reduced by the Enhanced program based on the roadside data using the number of vehicles in each model year, their travel frequency, and a correlation equation to convert the roadside test results (in terms of pollutant concentration) to on-road emissions in grams per mile. Table A-2 shows the emission rates and travel fractions used in this calculation. We multiplied the difference between the Before and After emission rates by the model year vehicle miles traveled (VMT) and the total number of vehicles in that model year to calculate the model year tons per day emissions reductions for each pollutant. We then summed the emission reductions over all model years to calculate the total tons per day emission reductions.

We used the draft EMFAC2000 model, which incorporates data from prior studies on the frequency of gas cap failures, to estimate the evaporative HC emission reductions achieved by the gas cap check. We estimated that Enhanced I/M reduced evaporative HC emission in all Enhanced I/M areas by 25 tons per day in 1999.

**Table A-2**  
**Roadside Test Results: Predicted FTP Emission Rates and Overall Emission Reductions Achieved by Enhanced I/M**  
**(1999)**

Model Year	Predicted FTP Emission Rates by Model-Year for Vehicles Tested on Roadside <b>After</b> a BAR97 ASM Smog Check Inspection*				Predicted FTP Emission Rates by Model-Year for Vehicles Tested on Roadside <b>Before</b> a BAR97 ASM Smog Check Inspection				EMFAC2000 Travel Fraction Numbers		Exhaust Emission Reductions			Percent Emission Reductions		
	# tested	HC mean (g/mi)	NOx mean (g/mi)	CO mean (g/mi)	# tested	HC mean (g/mi)	NOx mean (g/mi)	CO mean (g/mi)	Avg Annual VMT per Vehicle	Number of Vehicles	HC Emission Reductions (tons/day)	NOx Emission Reductions (tons/day)	CO Emission Reductions (tons/day)	HC % Reduction	NOx % Reduction	CO % Reduction
1966	24	8.62 +/- 2.31	1.86 +/- 0.46	97.6 +/- 32.4	24	8.62 +/- 2.31	1.86 +/- 0.46	97.6 +/- 32.4	4,747	53,895	0.00	0.00	0.00	0%	0%	0%
1967	20	10.77 +/- 5.35	2.34 +/- 0.68	109 +/- 39.7	20	10.77 +/- 5.35	2.34 +/- 0.68	109 +/- 39.7	4,882	52,517	0.00	0.00	0.00	0%	0%	0%
1968	29	7.81 +/- 3.28	2.2 +/- 0.52	77.1 +/- 25.2	29	7.81 +/- 3.28	2.2 +/- 0.52	77.1 +/- 25.2	5,097	56,954	0.00	0.00	0.00	0%	0%	0%
1969	17	9.62 +/- 4.94	3.16 +/- 1	96.9 +/- 39.8	17	9.62 +/- 4.94	3.16 +/- 1	96.9 +/- 39.8	5,406	67,527	0.00	0.00	0.00	0%	0%	0%
1970	30	6.83 +/- 1.81	2.65 +/- 0.65	78.2 +/- 24.7	30	6.83 +/- 1.81	2.65 +/- 0.65	78.2 +/- 24.7	5,581	67,262	0.00	0.00	0.00	0%	0%	0%
1971	22	6.08 +/- 1.76	2.66 +/- 0.69	77.9 +/- 31.6	22	6.08 +/- 1.76	2.66 +/- 0.69	77.9 +/- 31.6	5,858	63,591	0.00	0.00	0.00	0%	0%	0%
1972	32	9.25 +/- 7.66	2.59 +/- 0.67	77.1 +/- 24.4	32	9.25 +/- 7.66	2.59 +/- 0.67	77.1 +/- 24.4	6,182	78,583	0.00	0.00	0.00	0%	0%	0%
1973	62	8.18 +/- 2.99	2.43 +/- 0.37	79.1 +/- 17.5	62	8.18 +/- 2.99	2.43 +/- 0.37	79.1 +/- 17.5	6,419	90,103	0.00	0.00	0.00	0%	0%	0%
1974	14	6.82 +/- 5.92	3.17 +/- 1.18	52.6 +/- 26.8	42	9.05 +/- 4.3	3.16 +/- 0.63	73.4 +/- 20.4	6,709	78,837	3.56	-0.02	33.19	25%	0%	28%
1975	15	5.16 +/- 3.14	2.79 +/- 1.17	51.8 +/- 28.7	28	5.08 +/- 1.44	2.61 +/- 0.75	73.6 +/- 28	6,809	64,926	-0.11	-0.24	29.08	-2%	-7%	30%
1976	18	4.5 +/- 1.55	2.53 +/- 0.78	72 +/- 31.9	40	8 +/- 6.52	2.82 +/- 0.72	56.4 +/- 15.8	6,838	95,247	6.88	0.57	-30.66	44%	10%	-28%
1977	52	5.29 +/- 3.54	2.59 +/- 0.45	51.6 +/- 16.2	89	6.74 +/- 3.37	2.65 +/- 0.35	55.9 +/- 12.7	6,877	139,192	4.19	0.17	12.42	22%	2%	8%
1978	48	3.89 +/- 1.75	2.59 +/- 0.51	45.6 +/- 15.2	104	6.28 +/- 1.96	2.79 +/- 0.41	49.2 +/- 10.6	7,058	181,555	9.24	0.77	13.92	38%	7%	7%
1979	68	4.56 +/- 1.5	2.29 +/- 0.37	46.6 +/- 12.4	122	4.59 +/- 1.56	2.57 +/- 0.33	47.6 +/- 9.4	7,221	216,558	0.14	1.32	4.72	1%	11%	2%
1980	60	4.11 +/- 2.38	1.88 +/- 0.33	52.7 +/- 16.4	110	3.56 +/- 0.64	2.06 +/- 0.27	55.6 +/- 10.9	7,372	204,851	-2.51	0.82	13.21	-15%	9%	5%
1981	65	2.63 +/- 0.55	2.15 +/- 0.34	39.7 +/- 12	121	3.93 +/- 0.95	2.07 +/- 0.28	53.5 +/- 9.9	7,588	237,671	7.07	-0.44	75.09	33%	-4%	26%
1982	98	3.51 +/- 1.35	1.85 +/- 0.26	36.6 +/- 8.7	144	3.2 +/- 0.61	1.91 +/- 0.23	45.6 +/- 8	7,838	283,631	-2.08	0.40	60.37	-10%	3%	20%
1983	131	2.03 +/- 0.34	1.95 +/- 0.23	27.3 +/- 6.4	208	2.98 +/- 0.54	2.27 +/- 0.22	37.5 +/- 5.8	8,076	335,757	7.77	2.62	83.46	32%	14%	27%
1984	216	1.98 +/- 0.24	1.84 +/- 0.18	26.1 +/- 4.4	319	2.92 +/- 0.48	1.93 +/- 0.16	38.7 +/- 4.9	8,438	515,691	12.34	1.18	165.43	32%	5%	33%
1985	305	1.91 +/- 0.2	1.71 +/- 0.14	25.3 +/- 3.6	460	2.38 +/- 0.39	1.8 +/- 0.13	27.8 +/- 3.3	8,707	604,220	7.46	1.43	39.68	20%	5%	9%
1986	366	1.36 +/- 0.12	1.58 +/- 0.12	17 +/- 2.3	515	1.66 +/- 0.14	1.64 +/- 0.11	20.8 +/- 2.3	9,068	702,896	5.77	1.15	73.08	18%	4%	18%
1987	363	1.46 +/- 0.19	1.45 +/- 0.11	17.2 +/- 2.3	456	1.48 +/- 0.14	1.52 +/- 0.11	19.1 +/- 2.2	9,268	759,854	0.42	1.49	40.37	1%	5%	10%
1988	343	1.06 +/- 0.13	1.21 +/- 0.1	12.4 +/- 1.8	417	1.3 +/- 0.16	1.41 +/- 0.11	14.4 +/- 1.8	9,516	796,862	5.49	4.58	45.76	18%	14%	14%
1989	364	0.92 +/- 0.13	1.12 +/- 0.1	9.8 +/- 1.2	518	0.9 +/- 0.08	1.13 +/- 0.08	10.5 +/- 1	9,815	838,469	-0.50	0.25	17.38	-2%	1%	7%
1990	321	0.72 +/- 0.07	0.96 +/- 0.09	8.5 +/- 1	444	0.78 +/- 0.08	0.95 +/- 0.08	8.6 +/- 0.9	10,095	748,071	1.37	-0.23	2.28	8%	-1%	1%
1991	326	0.54 +/- 0.05	0.75 +/- 0.07	6.2 +/- 0.7	448	0.62 +/- 0.06	0.84 +/- 0.07	7.3 +/- 0.8	10,485	735,327	1.86	2.09	25.59	13%	11%	15%
1992	69	0.56 +/- 0.11	0.77 +/- 0.14	6.7 +/- 1.5	132	0.66 +/- 0.12	0.82 +/- 0.13	7.8 +/- 1.9	10,831	640,134	2.09	1.05	23.01	15%	6%	14%
1993	63	0.38 +/- 0.08	0.52 +/- 0.09	4.8 +/- 1.2	139	0.42 +/- 0.06	0.57 +/- 0.08	5.2 +/- 0.8	11,220	717,652	0.97	1.21	9.72	10%	9%	8%
1994	104	0.34 +/- 0.05	0.49 +/- 0.08	4.4 +/- 0.8	157	0.36 +/- 0.05	0.55 +/- 0.07	4.8 +/- 0.7	11,600	750,436	0.53	1.58	10.51	6%	11%	8%
1995	51	0.27 +/- 0.06	0.41 +/- 0.09	3.4 +/- 0.8	237	0.33 +/- 0.04	0.49 +/- 0.06	4.3 +/- 0.6	11,962	858,929	1.86	2.48	27.90	18%	16%	21%
1996	232	0.22 +/- 0.02	0.34 +/- 0.03	3 +/- 0.4	232	0.22 +/- 0.02	0.34 +/- 0.03	3 +/- 0.4	12,393	806,356	0.00	0.00	0.00	0%	0%	0%
1997	61	0.2 +/- 0.04	0.3 +/- 0.06	2.3 +/- 0.5	61	0.2 +/- 0.04	0.3 +/- 0.06	2.3 +/- 0.5	12,838	991,760	0.00	0.00	0.00	0%	0%	0%
1998	64	0.17 +/- 0.03	0.24 +/- 0.05	2 +/- 0.4	64	0.17 +/- 0.03	0.24 +/- 0.05	2 +/- 0.4	13,338	1,012,536	0.00	0.00	0.00	0%	0%	0%
1999	11	0.12 +/- 0.05	0.17 +/- 0.05	1.6 +/- 0.8	11	0.12 +/- 0.05	0.17 +/- 0.05	1.6 +/- 0.8	13,871	992,526	0.00	0.00	0.00	0%	0%	0%
Wt Avg:	4,064	1.029 +/- 0.06	0.89 +/- 0.3	12.1 +/- 0.06	5,854	1.19 +/- 0.06	0.94 +/- 0.02	13.7 +/- 0.4			73.8	24.2	775.5	13%	6%	12%

\*The 1973 and older, and the 1996 and newer vehicles were exempt from the biennial inspection requirements. Thus, the "Before" and "After" emission rates for these model years are the same.